Attention Based Time-Series Upscaling

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Overview

- *Background*
- Methodology
- Results
- Future Work

Background

- Growth in compute speed in supercomputers is out pacing growth in IO speed and storage by 10 to 1.
- Supercomputers are generating so much data so fast that we cannot save it fast enough and do not have enough storage to save high resolution time series data.
- Simulation science is exploratory by nature. We don't always know what we want a priori (beforehand)
- Interesting events can happen between save states.

What We Need

- Need to be able to explore the simulation in situ.
- Need to be able to extract information across large time steps while saving data infrequently.

What Has Been Done

- Conventionally scientists LERP between timesteps.
- Current research is into different machine learning models to infer data between timesteps.

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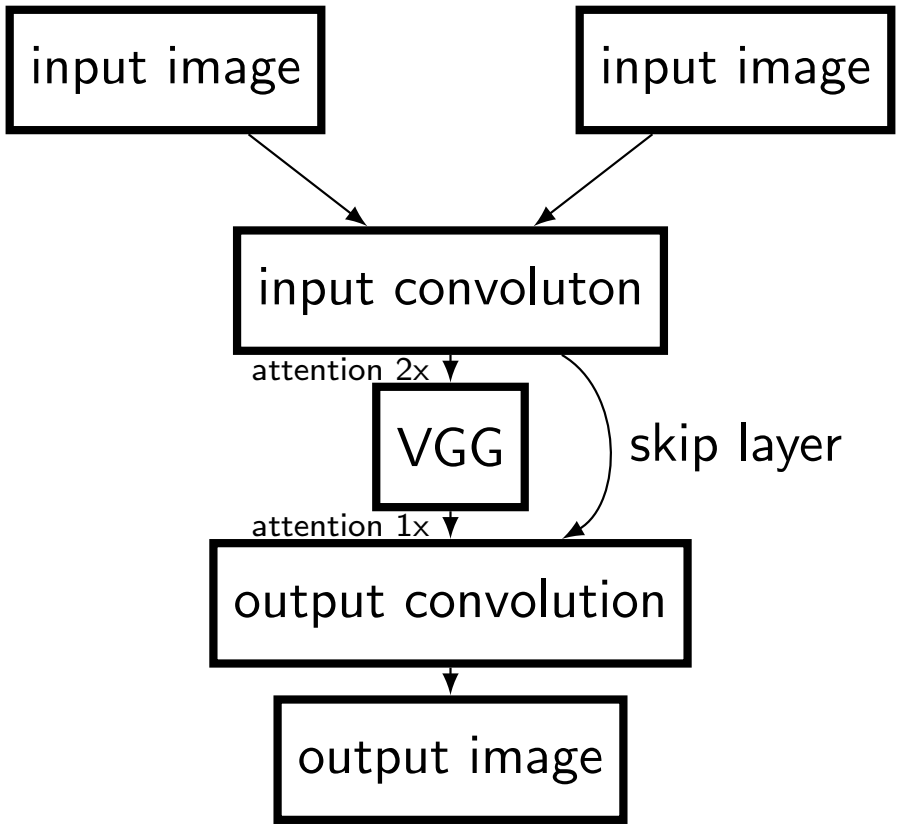
Methodology

- Generative based machine learning models are a promising avenue for time-series upscaling.
- Attention based networks are shown to be highly parallelizable and able to "remember" features through time-series data.
- Convolutional Neural Networks (CNNs) are computationally efficient and have proven effective in working with images.
- Model uses CNNs, skip layers, and self-attention to generate time-series upscalling.

Model


input image
input image
input convoluton
attention 2x
VGG
skip layer
attention 1x
output convolution
output image

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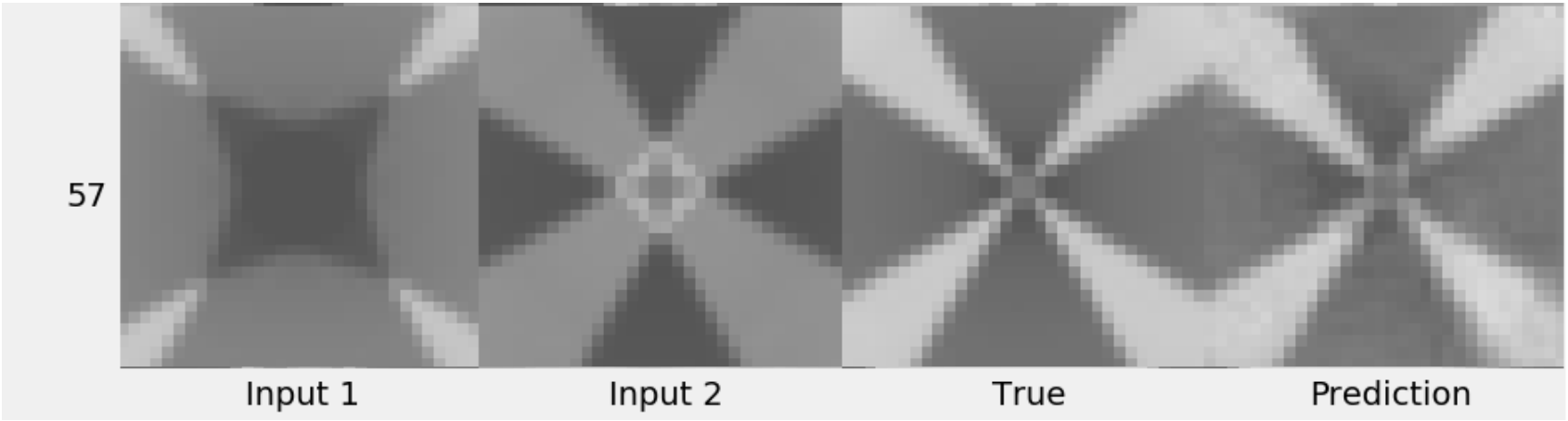
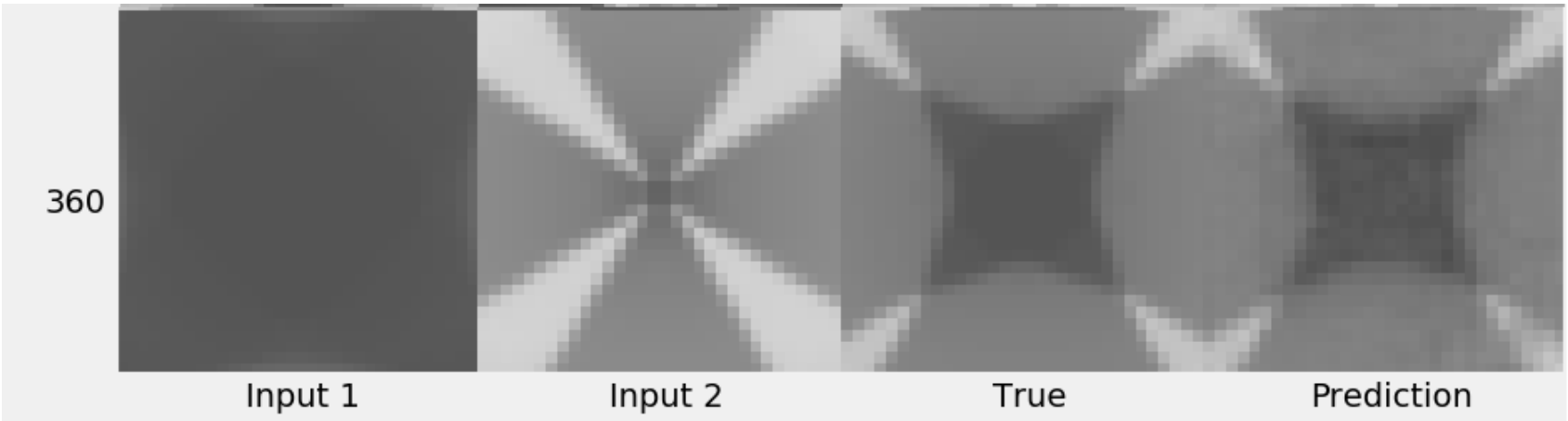
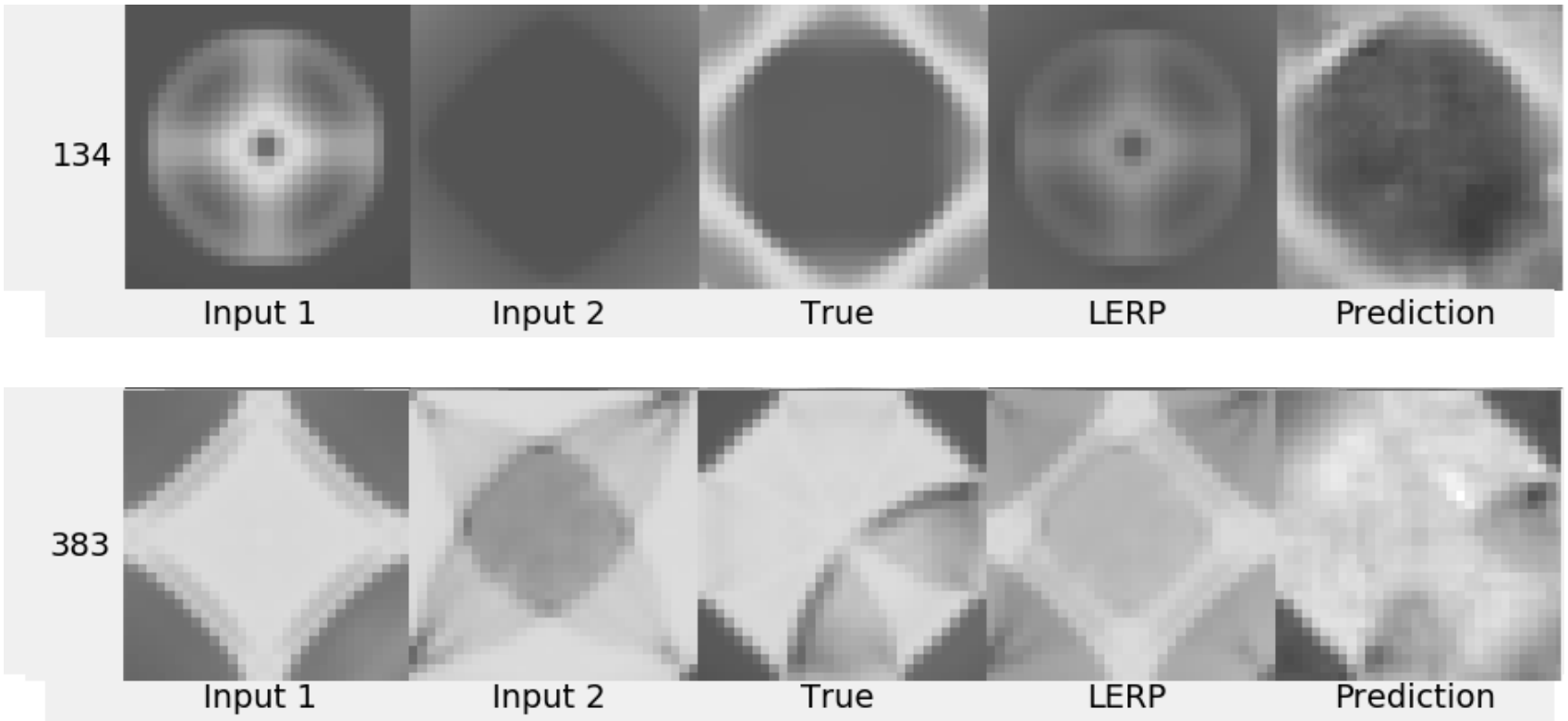
Results


57
Input 1
Input 2
True
Prediction


360
Input 1
Input 2
True
Prediction

Results


134
Input 1
Input 2
True
LERP
Prediction
383
Input 1
Input 2
True
LERP
Prediction

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Future Work

- Adapt so step size is modifiable (e.g. 30% form Image 1 and 70% from Image 2.)
- Fine time model to be more efficient.
- Use online learning methods.